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Hemodialysis without Ultra Filtration is more effective than with Ultra Filtration on Spirometry Parameters

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Abstract

Aim: Respiratory dysfunction is one of the most common problems among patients with end stage renal disease (ESRD). The aim of the present study is to evaluate the effects of hemodialysis (HD) with and without ultra filtration on various parameters of pulmonary function test among these patients.

Methods and Materials: one hundred sixty ESRD patients undergoing maintenance HD more than 3 months and without acute lung disease were included in the study. HD was done using Fresenius 4008B dialysis machines, synthetic dialyzer membranes, bicarbonate base dialysate and with zero to 1-4 lit ultra filtration rate during each session. Spirometry test was performed before and immediately after a 4-hour HD session and alterations in spirometry parameters including forced expiratory volume in first second (FEV1), forced vital capacity (FVC) and maximal mid expiratory flow rate (MMEF) were determined and their relations with ultra filtration rate were analyzed.

Results: The most common causes of ESRD were hypertension in 65 (40.6 %) and diabetes mellitus in 46 (27.7%). Three patterns in spirometry were found among our patients; obstructive, restrictive and normal pattern in 20%, 35.6% and 44.4% respectively.

There was a significant increase in FEV1, FVC and FEF 25-75% after dialysis (P < 0.001). But, the average rate of increment in FEV1 and FVC was higher in patients undergoing hemodialysis without ultra filtration versus ultra filtration and the difference was statistically significant (FEV1, P = 0.04 and FVC, P = 0.001).
Conclusion: According to the results of our study, spirometry parameters increase significantly after a session of HD but these increments were much more in patients undergoing HD without ultra filtration.

1. Introduction

Chronic kidney disease (CKD) is a pathophysiologic phenomen with multiple causes that leads to decrease nephrons and creates ESRD. Today, with extension of dialysis, the prognosis of the patients with ESRD has improved. Indication for dialysis in ESRD is uremic syndrome, hyperkalemia, sever acidosis unresponsive to medical therapy, sever hypervolemia, significant bleeding tendency, evidences of malnutrition and Cr clearance 10ml/min per 1/73m2.[1-5]

Respiratory system in renal diseases was affected by variable mechanisms which includes: hypervolemia, metabolic acidosis, pulmonary infection, metastatic calcification, pleural diseases, sleep apnea and myopathy due to uremia. Uremic lung in ESRD patients is different to pulmonary edema due to heart failure and ARDS Various mechanisms such as volume overload, left ventricular failure, hypoalbominemia and increased pulmonary microvascular permeability may favor edema formation. Sub clinical lung congestion in CKD can reduce pulmonary volumes and maximal expiratory flow rates which this value usually improve after dialysis. Treatment by hemodialysis causes reduction in arterial Po2 with amount of 10 to 15 mmHg after initiation of dialysis. Severity of hypoxemia depends on the type of dialysis membrane and dialysate buffer.(6-10)

Because of the most reasons of pulmonary edema due to renal failure involve volume overload and increased intra vascular volume, so treatment should include removal of excess body fluid by dialysis.(6-10) One of the results of dialysis is better respiratory function.(11)

Pulmonary function test is important for evaluation of pulmonary system. One of the major type of pulmonary function test is spirometry that measures FEV1, FVC, FEV1/FVC and expiratory flow rates.

Therefore, we decided to evaluate the effects of hemodialysis with and without ultra filtration on spirometry parameters.

2. Methods and Materials

This study was a cross-sectional study that was performed from 2008-2009. The ESRD patients on maintenance hemodialysis in Imam Khomeini hospital dialysis center were selected. The patients with GFR > 10%, impaired level of consciousness, need to mechanical ventilation , non cooperative for spirometry, uncontrolled heart failure and the patients who were on medical therapy with bronchodilator drugs, were excluded.

For each patient, ultra filtration and level of decrease of body weight through dialysis was determined by a nephrologist and on the basis of the post dialysis body weight in the last session, daily urinary output, dyspnea and ortopnea, and patient's vital signs.

Hemodialysis was performed for 4 hours by using synthetic dialyzer membranes and bicarbonate base dialysate. Blood flow rate, dialysate flow rate and ultra filtration rate were 250-400 ml/min, 500ml/min and 0-4

liter, respectively. Spirometry was performed before and half an hour after hemodialysis session. Alterations in spirometry parameters includes: forced expiratory volume in first second (FEV1), forced vital capacity (FVC) and maximal mid expiratory flow rate (MMEF) which were determined and their relations with ultra filtration rate were analyzed.

2.1 Statistical Analysis

At first, we studied with the use of descriptive statistic methods such as distribution of frequency, tables, mean and standard deviation and then the results of before and after dialysis were compared with paired T test and MC neamar test. A P value less than 0.05 was considered significant.

3. Results

A total of 160 HD patients (112 men and 48 women) with median age 51.36 years were included in this study. The causes of end-stage renal diseases were hypertension in 65 (40.6%), diabetes mellitus in 46 (27.7%), Autosomal dominant polycystic kidney disease in 10 (6.2%), glomerulopathy in 6 (3.7%), unknown source in 27 (16.8%) patients and other causes including uropathy in 6 (3.7%) patients. 86 patients were undergoing conventional hemodialysis without ultra filtration and 74 patients on hemodialysis with ultra filtration were compared. The prevalence of respiratory symptoms was determined by questionnaire. The prevalence of cough, dyspnea, and pleuretic chest pain was 43.8%, 23.8% and 21.3% respectively.

Three patterns in spirometry were found in this patients; obstructive, restrictive and normal pattern in 20%, 35.6% and 44.4% of patients. The most common pattern was normal pattern.

In both groups, after dialysis, there was a significant increase in FEV1, FVC and FEF 25-75% after dialysis ($P < 0.001$) table 1. Mean alteration in FEV1 after dialysis with ultra filtration was 2.08 % (CI 95% 0.86-3.3) in comparison without ultra filtration 4.48% (CI 95%2.59-6.31) ($P = 0.04$). Mean change in FVC after dialysis without ultra filtration was more than with ultra filtration (4.8% in comparison of 0.84% CI 95% 3.12-6.62) (P, 0.001). Increment in FEV1, FVC was much more in patients who were undergoing hemodialysis without ultra filtration. Mean increase FEF 25-75% post dialysis with UF was 7.35% (CI 95% 3.46-11.24) and in patients without UF was 3.97 %(CI 95% 0.84-7.10) ($P = 0.17$) which was not significant. *Table 2*

All of the patients had increase in FEF 25-75% with hemodialysis, but increment in FEV1 and FVC was 57.5% and 52.5% of patients. Hemodialysis with ultra filtration versus without UF creates increment in FEF 25-75% but statistically wasn't significant.

4. Discussion

Patients with ESRD and on hemodialysis treatment are exposed to multiple pulmonary conflicts. Pulmonary dysfunction may be the direct consequence of circulating uremic toxins or may result from volume overload and other mechanisms such as metabolic acidosis, pulmonary infection, metastatic calcification, pleural diseases, sleep apnea.(6-10) Impairment of spirometric parameters in patients with CKD is continual with reduction of GFR and thus small airways dysfunction may be seen not only in patients with end-stage renal diseases, but also in those with moderate GFR impairment.(12) Correlation between weight loss due to ultra filtration and improvement of spirometry parameters have not been determined exactly and different results in controversial articles are present.

The results of our study showed that FEV1, FVC and FEF 25-75% significantly improved in patients on hemodialysis, but increments in FEV1 and FVC were much more in patients undergoing hemodialysis without ultra filtration, and improvement of FEF 25-

75% had no significant difference between hemodialysis with and without ultra filtration. In comparison with the previous studies, our study had a priority which includes a variety of large samples.

Cury JL and his colleagues studied on Seventy-two participants who 32 of them were with CRF on dialysis for at least six months, ten patients with kidney transplants within six months earlier, and 30 healthy peoples as a control group. For all groups, spirometry, maximum inspiratory pressure (MIP), maximum expiratory pressure (MEP), and six-minute walking test (6MWT) were done. There was a decreased lung function in the dialysis group for FVC, FEV1, MVV, VC, MIP and MEP, and decreased FEV1 and MVV in the transplanted patients compared to the control group. Patients with CRF undergoing dialysis showed decreased functional capacity and lung function which these values were not completely reverted in the kidney transplant patients.(13)

Kovacevic and his members studied on 39 patients with CKD without cardiac and pulmonary diseases. These patients were on regular hemodialysis using bicarbonate or acetate mode. They reported that VC and FEV1 significantly increased in men whereas in female patients this improvement was not significant.(14)

According to the study of Rahgoshai and et all that evaluated 26 patients on maintenance dialysis for at least 3 months. The results showed after hemodialysis, the FVC significantly increased but no significant increment in the FEV1, VC, and FEV1/FVC ratio were found.(15)

Alves and his group evaluated 61 patients and they showed that the improvement of spirometry parameters after dialysis correlated with Ultra filtration (P = .03) (16), in spite of results of our study. But Navari and associates reported results of spirometry parameters in 41 patients. They found that increment of spirometry parameters just in patients were treated with dialysis by using bicarbonate dialysat. Post dialysis ultra filtration had no significant effects on spirometry parameters [(17)], the recent results was similar to our results.

Lang and et all evaluated fourteen clinically stable ESRD on hemodialysis who had no acute pulmonary problem, and they concluded that there isn't any correlation between Lung function and ultra filtration or duration of hemodialysis.(18) At the present study, our results about the comparison of hemodialysis with and without ultra filtration were similar to Navari and Lang`s study.

5. Conclusion

According to this study, it can be concluded that patients with ESRD undergoing dialysis have a better pulmonary function after dialysis and it may be due to extraction of toxins from blood instead of extraction of excess of water.

Conflict of interest

The authors have no conflicts of interest.

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TABLE 1. Mean Spirometry Measurements Before and After Hemodialysis

Factor	Before hemodialysis	After hemodialysis	P
FEV1, L	1.82 ± 0.52	1.91 ± 0.55	< 0.001
FVC, L	2.09 ± 0.63	2.1 ± 0.62	< 0.001
FEF25-75,L	2.28 ± 1.04	2.46 ± 1.10	< 0.001

TABLE 2. Mean Spirometry Alteration with and Without Ultra Filtration

Factor	With ultra filtration	Without ultra filtration	P
FEV1%	2.08 ± 5.26	4.45 ± 8.64	0.04
FVC%	0.84 ± 6.49	4.87 ± 8.4	0.001
FEF25-75%	7.35 ± 16.75	3.97 ± 14.52	0.177

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